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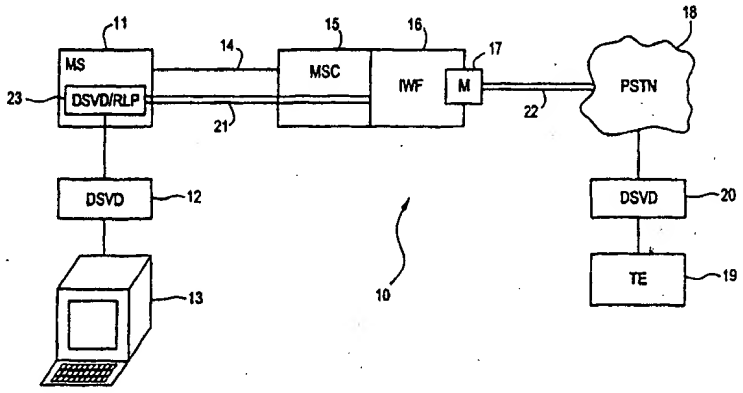


(57) Abstract

A system and method of simultaneously conducting a data transfer and a voice call between a mobile station (11) and a radio telecommunications network (10) having a mobile switching center (MSC) (15) which serves the mobile station. A first embodiment includes a landline digital simultaneous voice and data (DSVD) modem (12) associated with the mobile station which generates DSVD source signal and line negotiation protocols. The DSVD source signal and line negotiation protocols are encapsulated into circuit mode Radio Link Protocol (RLP) signals (21) and transmitted to the MSC. An interworking function (IWF) (16) associated with the MSC translates the circuit mode RLP signals into signals in a landline telecommunications protocol. In another embodiment, the voice call is carried over the air interface from the mobile station (31) to the network (30) in one timeslot, and the data transfer is carried in at least one additional timeslot on the same voice channel. In other embodiments, two voice channels may be allocated to the same mobile station. The voice call to a first party is carried from the mobile station to the network on one voice channel (34), and the data transfer to the first or a second party is carried on the second voice channel (33). The MSC (15) hands off the two voice channels together, but releases them individually when either the voice call or the data transfer is completed.

CELLULAR SIMULTANEOUS VOICE AND DATA TRANSMISSION INCLUDING DIGITAL SIMULTANEOUS VOICE AND DATA (DSVD) MODEM

BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to radio telecommunication systems and, more particularly, to a system and method of simultaneously transmitting voice and data in a digital radio telecommunications network.

Description of Related Art

There are several methods for providing simultaneous voice and data in the prior art, but the methods address the problem strictly from a landline perspective. Additionally, some landline methods are based on the Integrated Services Digital Network (ISDN) which utilizes entirely different channels for voice and data. ISDN is not really applicable to mobile telephony. In addition, ISDN solutions have the disadvantages of high access and equipment prices, and the lack of an ubiquitous ISDN service offering.

Digital landline modems capable of simultaneously transmitting voice and data are known as Digital Simultaneous Voice and Data (DSVD) modems. There is also an analog version called Analog Simultaneous Voice and Data (ASVD). When incompatible competing products began to appear on the market, a standards group called TR.30 began to develop a set of standards for digital landline modems.

A DSVD modem works on one channel and multiplexes the voice and data traffic. The DSVD modem takes a voice signal and digitizes and compresses it (i.e., encodes it) in an 8-kilobit bandwidth with a speech encoding algorithm in a digital codec. As required, data traffic utilizes the remainder of the available bandwidth on the channel. The TR.30 standards also provide for Voice Activity Detection (VAD) which continuously determines whether there is any voice activity on the channel. If there is no voice activity, then most of the modem bandwidth is reallocated to the sending of data during the gap in voice activity. When voice activity resumes, some of the bandwidth is reallocated to the transmission of voice. For example, if a system

radio telecommunications network either by utilizing existing IS-136 standards and network nodes, or by interworking DSVD modems within the nodes of the network.

Brown et al. disclose a reconfigurable modem interface compatible with the GSM system which doubles the number of simultaneous video and voice transmissions per channel. However, Brown et al. describe a complex implementation utilizing half-rate voice coding based on a modified vector sum excited linear prediction (VSELP) algorithm, and utilizing variable rate codecs. Brown et al. do not teach or suggest a system which simultaneously transmits voice and data in a digital radio telecommunications network either by utilizing existing IS-136 standards and network nodes, or by interworking DSVD modems within the nodes of the network, thereby providing a simple implementation suitable for simultaneous voice and moderate data requirements.

Review of each of the foregoing references reveals no disclosure or suggestion of a system or method such as that described and claimed herein.

In order to overcome the disadvantage of existing solutions, it would be advantageous to have a system which interworks DSVD modems with a cellular radio system in a simple implementation suitable for simultaneous voice and moderate data requirements. The present invention provides such a system. The present invention also simultaneously transmits voice and data in a digital radio telecommunications network by utilizing existing IS-136 standards and network nodes. Additionally, ASVD modems may be utilized for analog transmissions.

SUMMARY OF THE INVENTION

The present invention is a system and method for efficiently supporting the use of DSVD modems with a digital cellular radio telecommunications network. The method enables a mobile subscriber to perform such functions as, for example, talking while he is also transmitting whiteboard application information. One such application allows a mobile subscriber to utilize a display screen and receive pen cursor drawings while talking to the calling party at the same time. The data bandwidth for this type of application can be handled by off-the-shelf DSVD modems. The present invention supports these types of applications in cellular networks utilizing standard off-the-shelf DSVD modems.

telephone number for the data transfer, assigning within the MSC a first timeslot for the voice call and at least one additional timeslot for the data transfer, and delivering the data transfer to the destination telephone number while continuing the voice call.

In yet another aspect, the present invention is a method of simultaneously conducting a data transfer and a voice call between a mobile station having first and second transmitter/receiver pairs, and a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station. The method begins by notifying the MSC that a simultaneous voice and data call with the mobile station is desired, allocating a first voice channel to the first transmitter/receiver pair in the mobile station, and allocating a second voice channel to the second transmitter/receiver pair in the mobile station. This is followed by establishing the voice call on the first voice channel, and establishing the data transfer on the second voice channel.

In yet another aspect, the present invention is a method of simultaneously conducting a data transfer and a voice call between a mobile station having a first transmitter/receiver pair, and a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station. The method begins by connecting the mobile station to a data terminal through a modem having a second transmitter/receiver pair, notifying the MSC that a simultaneous voice and data call with the mobile station is desired, allocating a first voice channel to the first transmitter/receiver pair in the mobile station, and allocating a second voice channel to the second transmitter/receiver pair in the modem. This is followed by establishing the voice call on the first voice channel, and establishing the data transfer on the second voice channel.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawing, in conjunction with the accompanying specification, in which:

FIG. 1 is a block diagram illustrating the components of a radio telecommunications network which has been modified to incorporate a first embodiment of the present invention;

FIG. 11 is a process diagram illustrating the steps performed by the present invention in an embodiment in which a simultaneous voice and data connection is made between a mobile station and the PSTN while utilizing DSVD processes in the interworking function (IWF).

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention simultaneously transmits voice and data in a digital radio telecommunications network. Several embodiments are disclosed herein, including: (1) DSVD interwork utilizing two distinct mobile channels; (2) DSVD interwork utilizing a single mobile channel; and (3) simultaneous voice and data utilizing two distinct and independent mobile channels or mobile channel frequencies without DSVD interwork.

FIG. 1 is a block diagram illustrating the components of a radio telecommunications network 10 which has been modified to incorporate a first embodiment of the present invention. The first embodiment utilizes TR.30 DSVD interworking to provide simultaneous voice and data on a single digital traffic channel in the radio telecommunications network 10. A mobile station (MS) 11 is connected through part of a DSVD modem 12 to a terminal such as a computer terminal 13 for a mobile subscriber's use when utilizing simultaneous voice and data features. Alternatively, the functions of the MS, modem, and computer terminal may be combined in a single device. The MS 11 is connected via a standard air interface link 14 to a Mobile Switching Center (MSC) 15. A base station linking the MS 11 and the MSC 15 has been omitted for simplicity. The air interface link 14 may be a standard Time Division Multiple Access (TDMA) radio link according to the IS-136 standard which is hereby incorporated by reference herein. However, the present invention is also applicable to other mobile telecommunications technologies such as the Global System for Mobile Communications (GSM), the Pacific Digital Cellular (PDC) System, etc.

The MSC 15 may directly or indirectly connect to an Interworking Function (IWF) 16. The IWF 16 is logically connected to the call to provide interworking between the mobile-specific protocols utilized on the air interface and landline specific protocols utilized with data transmissions. For example, the IS-136 air interface

TDMA context, a multi-slot channel resource may be required to provide sufficient air-interface bandwidth.

FIG. 2 is a communications profile illustrating the communications protocols utilized, and the protocol translations performed while making the connection of FIG. 1 utilizing parts of a DSVD modem. Communications are shown between the MS 11, a base station 46, the MSC 15, the IWF 16, the PSTN 18, and a DSVD modem 20 which may connect other terminal equipment to the PSTN. A DSVD application 47 in the MS 11 ultimately communicates at the application layer with a DSVD application 48 that is running on a DSVD-connected terminal. At lower layers, there is a DSVD baseband layer 49 which is utilized in the MS 11, the MSC 15, the IWF 16, and the DSVD modem 20. Below that, an IS-130 layer 51 operates between the MS 11 and the MSC/IWF functional conglomerate. An IS-136 layer 52 operates between the MS 11 and the base station 46. The base station 46 communicates with the MSC 15 utilizing transmission protocols that may be proprietary to the equipment manufacturer. Within the IWF 16, the modem device 17 modulates the DSVD bit stream, and generates a voice band signal 53 which is sent to the PSTN 18.

FIG. 3 is a process diagram illustrating the steps performed by the DSVD/RLP function 23 of FIG. 1. A voice signal 61 is digitized and sampled in a voice digitizer and sampler 62. The voice signal then passes through a switch 63 to a digital speech interpolation and voice activity detection function 64. From there, the signal enters a digital codec 65. The output of the codec is applied to a DSVD multiplexer 66. Simultaneously, a data signal 67 enters a data compressor and framer function 68. The output of the data compressor and framer function is applied to the DSVD multiplexer 66. The output of the multiplexer is a multiplexed DSVD bit stream which is encapsulated at 69 into the circuit mode RLP frame stream as specified by, for example, IS-130. The RLP frame stream is then formatted into TDMA slots and transmitted in the IS-136 slot formatter and radio transmitter 70.

There are two major types of TDMA-RLPs, a "transparent" RLP and a "non-transparent" RLP. The transparent RLP utilizes a fixed data rate and a variable error rate. The non-transparent RLP utilizes a variable data rate and a fixed error rate. Because of concerns regarding latencies that arise when transporting voice information on a non-transparent service, the configuration shown in FIG. 4 is preferably supported

utilizing a time-division multiplexing technique. The multiplexed stream is then modulated through the modem device 38 which is connected to landline networks such as the PSTN 39.

In an alternative embodiment, two different codecs are utilized in the IWF 37, and an intermediate Pulse Code Modulation (PCM) or Adaptive PCM (ADPCM) conversion may be required between the radio voice codec (e.g., VSELP, ACELP) and DSVD. The intermediate PCM conversion performs successive radio-voice-codec-to-PCM and PCM-to-DSVD conversions within the IWF 37.

Each TDMA frame comprises six timeslots, and each full-rate voice user occupies two of those timeslots. The present invention avoids a multi-frequency mobile implementation supporting two frequencies by utilizing from one to four of the available timeslots in the TDMA frame for data. The bandwidth available to the user therefore ranges anywhere from 4.8 to 19.2 kbps. In the embodiment shown in FIG. 4, the bandwidth allocated to voice is static. A variable rate codec could be utilized, however, that may require a change in the existing TDMA structure.

While this embodiment lacks some of the simplicity of the embodiment shown in FIG. 1, it provides for greater robustness, simplified rationalized mobile terminals, and greater air-interface flexibility. The mobile station 31 can reuse the codec 35 which is already in the mobile station, and the TDMA structure can treat the voice connection and the data connection as independent connections for the most part. However, coordination at the cellular system level is required since, for example, both connections should hand off at the same time and maintain the same physical layer settings. Examples of the coordination and the required triggers toward the cellular system in order to recognize the operation and successfully introduce the IWF are given in the embodiments of the present invention that follow.

A number of industry standards have been developed by the TR.30.1 working group (PN 3359), and are applicable to the present invention. These are V.8bis, V.34 or V.34Q, V.70, V.75, V.76, V.61, G.729, and IS-136 rev B. The V.8bis standard is essentially a signaling standard which specifies line negotiation and enables the dynamic reallocation of bandwidth to data when there is no voice activity. The V.34 and V.34Q standards cover modulation. There are some control procedures in V.75, and V.76 includes standards for the multiplexer. The V.61 standard covers analog

network components can recognize and use in order to perform the service. A data terminal 74 such as a computer, is connected through a modem 75 to a mobile station (MS) 76. The mobile station communicates over an air interface to a base station 77 which is connected via landline, microwave links, or other suitable communication links to a MSC 78. The MSC may be connected to a modem bank (not shown) for carrying the data part of the call. Alternatively, the MSC may include a standard Interworking Function (IWF) 79 as is known in the art. Functions performed in the IWF include rate adaptation between the transmission rate over the air interface and the transmission rate over the land lines. Thus, the IWF performs flow control, error control, data buffering, encryption, compression, DSVD processing (as in FIG. 10), etc. The MSC communicates with the PSTN 81.

The following scenario assumes that a subscriber is involved in a telephone voice conversation. During the conversation, the need to transfer a document arises. In this embodiment, the following steps then take place:

a) The user connects the MS 76 to the regular cellular modem 75;

b) The links between the MS 76, the modem 75, and the data terminal 74 are established;

c) The subscriber initiates a "Simultaneous Voice/Data Call". This may be performed by, for example, pressing a key combination on the MS (for example, *35), indicating that a data transfer is about to take place, and pressing the "flash" key. This results in the MS initiating the Simultaneous Voice/Data Call. The actual key combination that is pressed on the mobile may be a single predefined key stroke, a menu choice, a *XX key combination, etc. The subscriber action indicates to the MSC the need to introduce the IWF in the call path so that proper coordination occurs.

FIG. 7 is a message flow diagram illustrating the flow of messages, and actions taken, when originating a simultaneous voice and data call according to the teachings of the present invention. Referring to FIGs. 6 and 7, the MS 76 sends an Origination Request (ORREQ) or Flash message 85 to the MSC 78. If the subscriber is not already involved in a voice call, and desires to originate a simultaneous voice/data call, then an ORREQ message is sent. If, however, the subscriber is already involved in a voice call, a Flash message is sent. The ORREQ or Flash message may include a

The above describes the origination of a simultaneous voice and data call. Obviously, two simultaneous voice calls or two simultaneous data calls may also be placed by the method described above.

FIG. 8 is a message flow diagram illustrating the flow of messages, and actions taken, when a terminating simultaneous voice and data call is directed toward a mobile station according to the teachings of the present invention. Referring to FIGs. 6 and 8, the MSC 78 sends a message 91 to the MS 76 and includes the simultaneous data bit indicating that a simultaneous voice and data call is being directed to the MS. The message 91 may be, for example, an Alert-with-Info message or a page. At 92, the MSC 78 takes the steps to connect the incoming call to the MS, to reallocate timeslots as required to support the requested service, and utilizes its existing IWF 79 to separate the voice and data calls. The MSC then begins transmission of the voice and data calls to the MS at 93 by assigning a plurality of timeslots or voice channels to the MS and utilizing multi-slot transmissions.

FIG. 9 is a block diagram illustrating the components of a radio telecommunications network in an embodiment in which a simultaneous voice and data connection is made between a mobile station and the PSTN utilizing separate voice channels for voice and for data according to the teachings of the present invention. Simultaneous voice data transmission is achieved, not by using DSVD modems, but by assigning two simultaneous voice channels to the same mobile station, and utilizing one channel for voice and the other channel for data. A data terminal 101 such as a computer, is connected through a modem 102 to a two-channel MS 103. The MS has two transmitter/receiver (tx/rx) pairs that can operate simultaneously on different frequencies. Thus, the MS may communicate over voice channel 104 and data channel 105 to a base station 106 which is connected via landline, microwave links, or other suitable communication links to a MSC 107. The MSC includes a standard IWF 108 as is known in the art, and as previously described (FIG. 6). The MSC communicates with the PSTN 109.

The user initiates a simultaneous voice-data call by pressing a * combination feature code or by dialing the same number of the originally dialed destination. Once the MSC has recognized that a simultaneous voice-data call is to be setup, the MSC allocates a second voice channel to the MS. This step may involve authentication and

asynchronous or synchronous HDLC-based data protocol such as X.25 between the two devices will suffice. The MS communicates with a base station 115 which is connected via landline, microwave links, or other suitable communication links to a MSC 116. The MSC includes a standard IWF 117 as is known in the art. The MSC communicates with the PSTN 118. Thus, the MS may communicate over voice channel 104 and data channel 105 to a base station 106

The user initiates a simultaneous voice-data call by pressing a * combination feature code or by dialing the same called number of a call which may be ongoing on voice channel 119. Once the MSC 116 has recognized that a simultaneous voice-data call is to be setup, the MSC allocates a second voice channel 120 to the MS 114. Once the MS has received the information regarding the second voice channel, the MS instructs the modem 112 to tune to the second voice channel 120 utilizing the tx/rx pair 113. Once the modem has finished the setup procedure, it instructs the MS that the setup is complete. In turn, the MS instructs the MSC that setup is complete. Authentication of the second voice channel is performed once the message that setup is complete has been received by the MSC. This is required so that fraud opportunities are minimized (voice channel hi-jacking). Also, among the information that the MS is passing to the modem device is the authentication data (A-key). This is done so that MSC-initiated challenges can be responded to properly by the modem. From that point on the two devices may act independently, with the modem 112 transmitting and receiving data over the second voice channel 120. The MSC may coordinate events such as handoff to ensure that both channels are handed off together.

Thus, in this embodiment, the MS 114 acts as a coordinator with another cellular device (e.g., modem) in way that can be described as "master-slave". This removes the complexity required in the mobile from the previous embodiment.

Like the previous embodiment, additional logic is introduced in the MSC 116 to treat termination cases intelligently. When a call on one of the two channels ends, the MSC releases only that channel. The subscriber is not marked idle, however, until both channels are free. This allows for the voice conversation to continue after the data transfer has been completed, and the data channel has been released. Also, the data transfer (e.g., fax) can continue after the user has confirmed that the receiving

(ACELP) or other digital voice codecs. In one embodiment, the voice frames may be Alternate Full Rate (AFR) frames. The AFR codec is an ACELP codec utilized in IS-136 TDMA systems as an alternate to Vector Sum Excitation Linear Predictive (VSELP). There are several alternative methods of translating between Voice AFR and the three commonly used Voice-over-IP algorithms. The simplest method is to utilize an intermediate PCM conversion so that there are successive AFR-to-PCM and PCM-to-Voice-over-IP conversions within the IWF. Another method is to utilize voice encoding mapping directly between the Voice AFR voice encoding algorithm and the Voice-over-IP voice encoding algorithm. This works well when the two codecs are derived from the same codec family.

It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the method, apparatus and system shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the spirit and scope of the invention as defined in the following claims.

means for modulating and transmitting said signals in a landline telecommunications protocol to a landline telecommunications network.

4. The system for interworking digital simultaneous voice and data (DSVD) modems with a radio telecommunications network of claim 3 wherein said means within said mobile station for passing a data signal between said MSC and an applications terminal connected to said mobile station includes a data compressor and framer.

5. The system for interworking digital simultaneous voice and data (DSVD) modems with a radio telecommunications network of claim 4 further comprising, within said mobile station:

a voice digitizer and sampler which digitizes the voice signal prior to sending the voice signal to the digital codec;

a DSVD multiplexer which multiplexes the output of the digital codec and the output of the data compressor and framer;

means for formatting the output of the DSVD multiplexer in the circuit mode RLP;

a slot formatter which formats the circuit mode RLP into Time Division Multiple Access (TDMA) timeslots; and

a radio transmitter which transmits the multiplexed and formatted voice and data signals from the mobile station to the MSC.

6. A method of initiating and conducting a data transfer from a mobile station simultaneously with an ongoing voice call from the mobile station to a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station, said method comprising the steps of:

establishing the voice call between the mobile station and a called party telephone number utilizing a first timeslot;

connecting said mobile station to a data terminal through a modem;

notifying said MSC from said mobile station that a data transfer is desired;

11. A method of simultaneously conducting a data transfer to a first destination telephone number and a voice call to a second destination telephone number, said transfer and call being made between a mobile station and a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station, said method comprising the steps of:

connecting said mobile station to a data terminal through a modem;

notifying said MSC from said mobile station that a simultaneous voice and data call is desired;

assigning within said MSC, a first timeslot for a voice call and at least one additional timeslot for a data transfer;

providing said MSC with the first destination telephone number for the voice call;

providing said MSC with the second destination telephone number for the data transfer;

establishing the voice call between the mobile station and the first destination telephone number; and

establishing the data transfer between the mobile station and the second destination telephone number while continuing the voice call.

12. The method of simultaneously conducting a data transfer and a voice call between a mobile station and a radio telecommunications network of claim 11 wherein said step of notifying said MSC from said mobile station that a simultaneous voice and data call is desired includes transmitting a simultaneous voice/data parameter in an origination message from the mobile station to the MSC.

13. A method of initiating and conducting a data transfer to a mobile station simultaneously with an ongoing voice call between the mobile station and a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station, said method comprising the steps of:

establishing the voice call utilizing a first timeslot;

notifying said mobile station from said MSC that a data transfer to the mobile station is desired;

18. The method of simultaneously conducting a data transfer and a voice call of claim 16 further comprising, before the step of allocating a second voice channel to the second transmitter/receiver pair in the mobile station, the step of performing an authentication to prevent fraud.

19. The method of simultaneously conducting a data transfer and a voice call of claim 16 further comprising the step of handing off both the first and second voice channels together when the mobile station moves from one cell to another cell.

20. The method of simultaneously conducting a data transfer and a voice call of claim 16 further comprising individually releasing only the first voice channel when the voice call is completed and the data transfer is continuing.

21. The method of simultaneously conducting a data transfer and a voice call of claim 20 further comprising individually releasing only the second voice channel when the data transfer is completed and the voice call is continuing.

22. The method of simultaneously conducting a data transfer and a voice call of claim 20 further comprising marking the mobile station as idle when both the voice call and the data transfer are completed.

23. A method of simultaneously conducting a data transfer and a voice call between a mobile station having a first transmitter/receiver pair, and a radio telecommunications network having a mobile switching center (MSC) which serves the mobile station, said method comprising the steps of:

connecting the mobile station to a data terminal through a modem having a second transmitter/receiver pair;

notifying said MSC that a simultaneous voice and data call with said mobile station is desired;

allocating a first voice channel to the first transmitter/receiver pair in the mobile station;

Multiple Access (TDMA) radio telecommunications network having a mobile switching center (MSC) which serves the mobile station and an Interworking Function (IWF) associated with the MSC, said method comprising the steps of:

establishing the voice call between the mobile station and a called party telephone number utilizing a first timeslot;

initiating by the mobile station, the data transfer;

notifying said MSC from said mobile station that a digital simultaneous voice and data (DSVD) data transfer is desired;

seizing by said MSC, the IWF;

seizing by said MSC, at least one additional timeslot for the data transfer;

notifying said mobile station from said MSC that the DSVD data transfer is granted; and

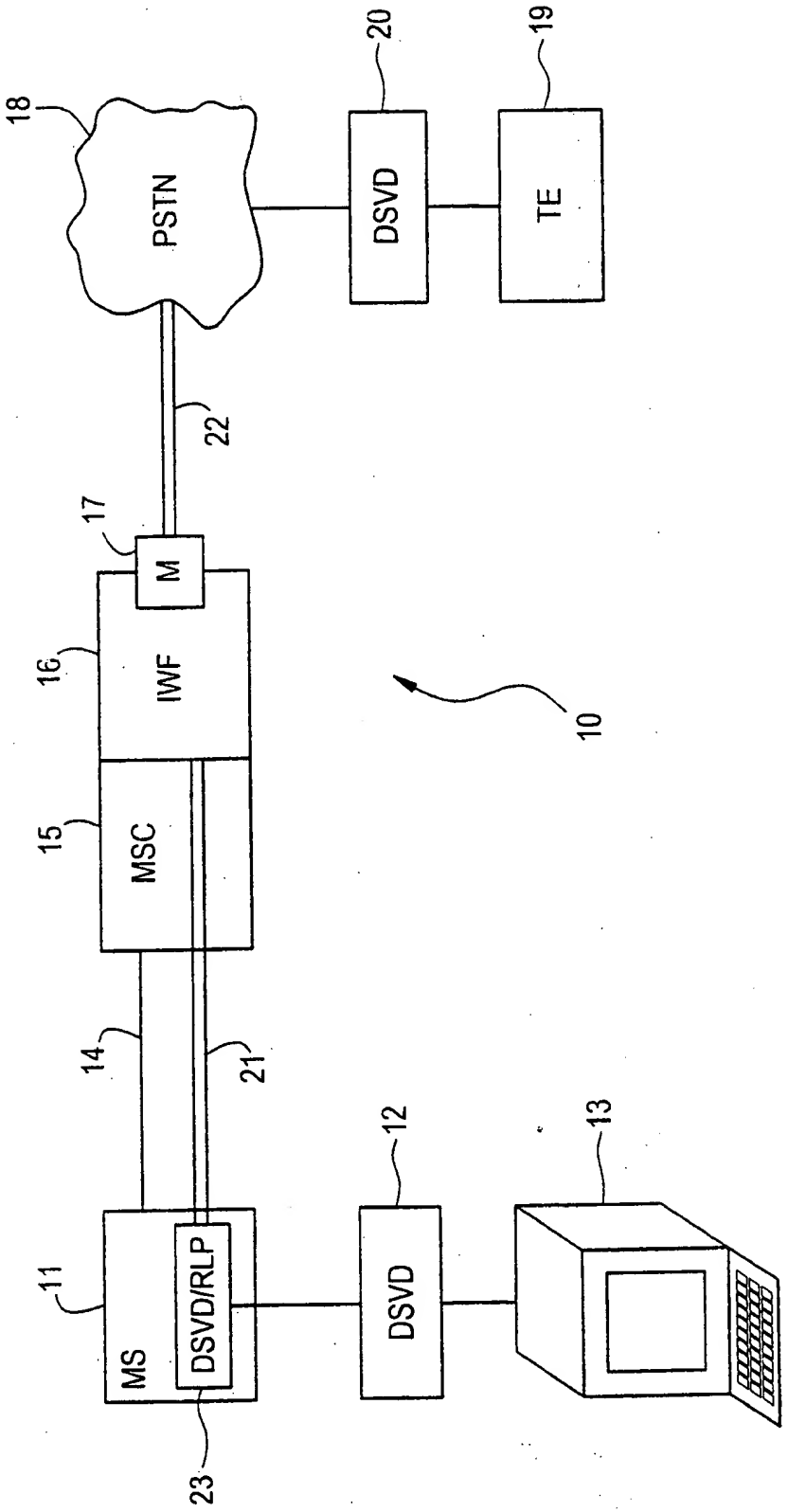
transferring the data from the mobile station to the network utilizing the additional timeslot.

31. The method of initiating a data transfer from a mobile station simultaneously with an ongoing voice call from the mobile station to a TDMA radio telecommunications network of claim 30 further comprising, after the step of notifying said MSC from said mobile station that a DSVD data transfer is desired, the step of verifying by the MSC that the mobile station is authorized for DSVD service.

32. The method of initiating a data transfer from a mobile station simultaneously with an ongoing voice call from the mobile station to a TDMA radio telecommunications network of claim 30 wherein said step of seizing by said MSC, at least one additional timeslot for the data transfer includes seizing at least one additional adjacent timeslot on the same radio channel as the voice call.

33. The method of initiating a data transfer from a mobile station simultaneously with an ongoing voice call from the mobile station to a TDMA radio telecommunications network of claim 30 wherein the mobile station communicates over a radio link to the MSC utilizing a radio link protocol (RLP), and the method

FIG. 1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PSTN
20
DSVD
19
TE
22
17
M
16
IWF
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MSC
14
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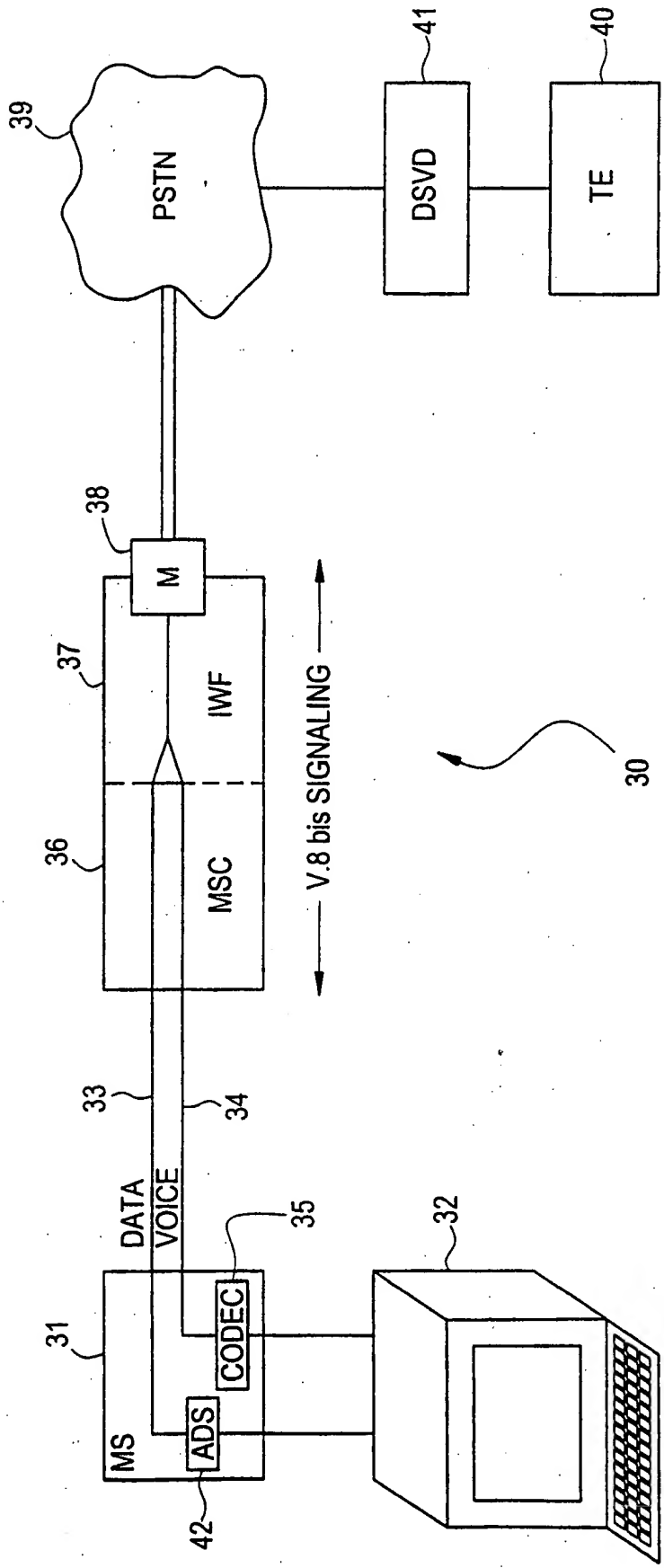
13
11
MS
DSVD/RLP
DSVD
23

FIG. 4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PSTN
41
DSVD
40
TE
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M
37
IWF
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MSC
V.8 bis SIGNALING
30
33
34
DATA
VOICE
35
32
31
MS
CODEC
ADS
42

FIG. 6

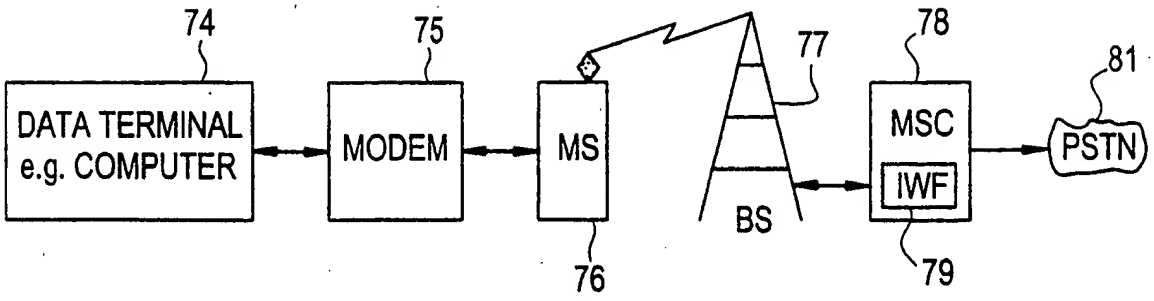
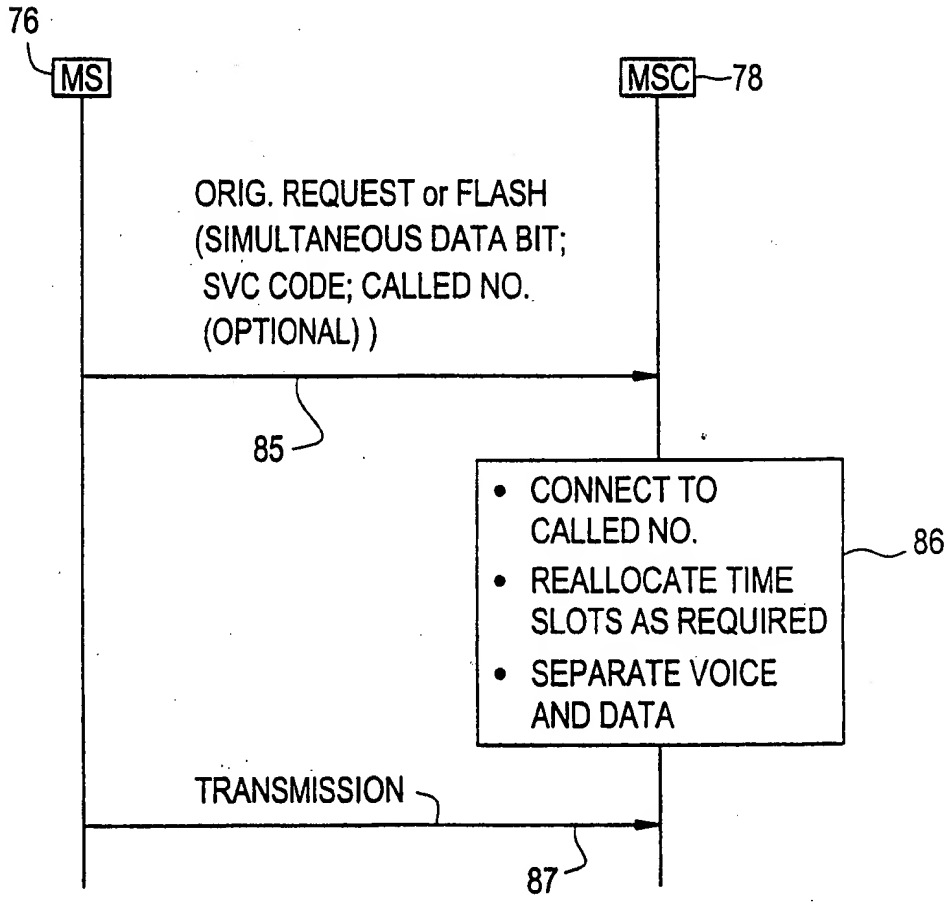

74
75
77
78
81
DATA TERMINAL
e.g. COMPUTER
MODEM
MS
BS
MSC
IWF
PSTN
76
79

FIG. 7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MS
MSC
78
ORIG. REQUEST or FLASH
(SIMULTANEOUS DATA BIT;
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(OPTIONAL))
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• REALLOCATE TIME SLOTS AS REQUIRED
• SEPARATE VOICE AND DATA
86
TRANSMISSION
87

FIG. 9

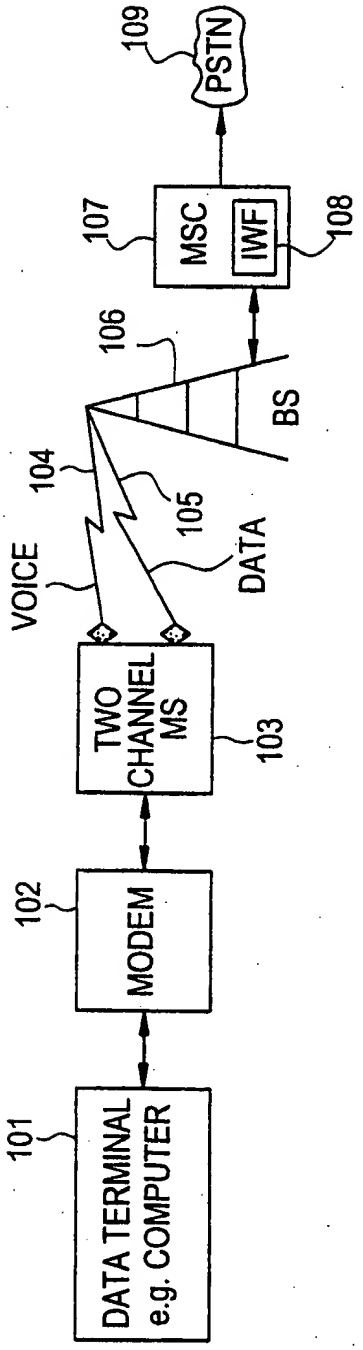
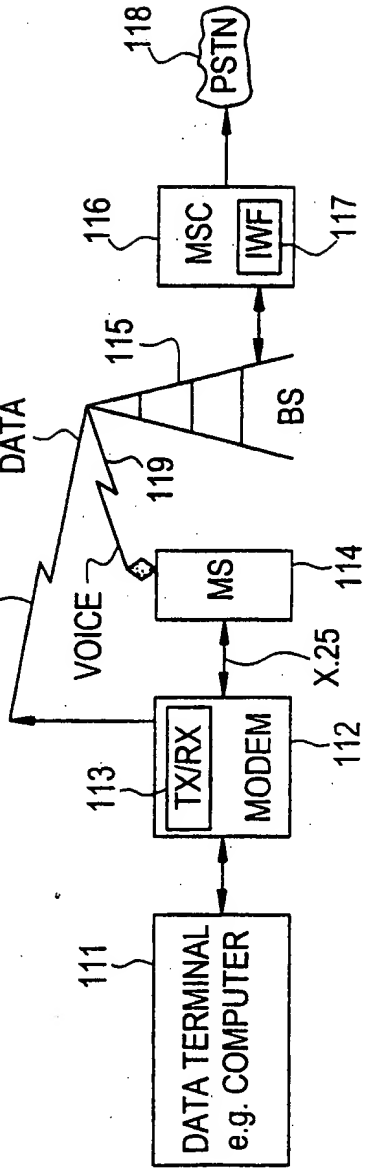

DATA TERMINAL e.g. COMPUTER
101
MODEM
102
TWO CHANNEL MS
103
VOICE
104
DATA
105
BS
106
MSC
107
IWF
108
PSTN
109

FIG. 10


DATA TERMINAL e.g. COMPUTER
111
TX/RX
MODEM
113
112
X.25
MS
114
VOICE
120
DATA
119
BS
115
MSC
116
IWF
117
PSTN
118

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M H04B H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 590 406 A (BAYLEY ET AL) 31 December 1996 (1996-12-31) column 3, line 54 - column 7, line 24 figure 3 ---	6,11,13, 16,23,30
A	WO 97 19569 A (PHILIPS ELECTRONICS NV ;PHILIPS NORDEN AB (SE)) 29 May 1997 (1997-05-29) page 2, line 5 - page 3, line 6 page 6, line 18 - page 8, line 3 ---	6,11,13, 16,23,30
A	EP 0 801 513 A (LUCENT TECHNOLOGIES INC) 15 October 1997 (1997-10-15) column 4, line 35 - column 6, line 47 --- -/--	1,3,30

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 July 1999	30/07/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Palencia, C

Form PCT/ISA/210 (second sheet) (July 1992)

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